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# A CASE STUDY ON ASSESSING ENERGY EFFICIENCY OF EXISTING RESIDENTIAL BUILDING AND RECOMMENDATIONS ENSURING GREEN EFFICIENCY IN BUILDING CONSTRUCTION PROJECTS

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**ABSTRACT**

*Energy Efficiency is an important aspect in the construction of a residential building. Energy Consumption in the building is approximately 8% of electricity and 3.5% of the natural gas. As the increasing in consumption will increase the environmental damage as well as the building interior climatic condition. Heat, Ventilation and Air Conditioning (HVAC) system and lightning system are the major factors that influence energy consumption. In the same way there are climatic issues along with global warming which cannot sustain current economic development activities. So, as to reduce the environmental damage and to make the building energy efficient, certain green techniques must be recommended. By keeping this in view, the paper deals with the case study on residential building and identifying the causes where heavy energy consumption is done and taking them in to consideration and also suggesting green efficiency recommendations for an existing building.*

**Key words:** Energy efficiency, Green efficiency, Green Techniques, Residential Building, Environmental protection.

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# 1. INTRODUCTION

The impact of energy consumption and climatic conditions surrounding the building is effective and has increased global attention on building efficiency [1]. Increasing growth in population and uncontrolled development rate is burdening the non-renewable and finite resources that are available. Also the rapid increase in urbanization has shown its impact on environment and air pollution [4].The possibility of energy in the building is from electricity and non-renewable resources, hence this became a serious issue in the world environment [9].Maintaining the sustainability in the building sector is the main goal in construction industry. Green design and construction principles will offer a way to introduce numerous benefits in construction industry including better energy efficiency. The improved performance of indoor environmental quality, increase health and occupant productivity with minimization of resource usage in the construction process and throughout the life time of building [10].

# 2. METHODOLOGY

In the previous studies it has been stated and concluded that the Building would be affected by building materials, orientation and temperature surrounding the building, ventilation and insulation. These are the main factors that affect the building. The information thus gathered as follows.

## 2.1. Building Details

**Table 1** Details of building infrastructure

| | |
|---|---|
| Structure | RCC Framed Structure |
| Walls | 9" External wall, 4.5" internal wall |
| Flooring | Vitrified Tiles |
| Wood Work | Main door& shutter with polish take wood, Internal door frames with take wood and flush door, window shutters are with take frame and pin head glass and MS safety grills |
| Electrical work | Concealed copper wire with adequate no. of lighting and fan points with AC and geyser wiring in master bedroom, other switches boards etc., |
| Water lines | CVPC water line with standard pipes |
| Painting | Single Coat with DOB paints in the flats, for elevation emulsion paints |
| Water | Municipal and Bore water will be provided |
| Kitchen | Black granite platform, 2 ft. dawdling up to door height points for grinder, rice cooker etc., |
| Toilets | Ceramic flooring with anti-squid type, wall tiles dawdling up to door height, one Indian commode and one European W.C |
| Cupboards | Cement planks up to 250 ft. |

## 2.2. Data Collection

The data collected for the building are the cases where temperature, wind and hours of sun shine have been recorded and were tabulated as follows:

**Table 2** Data collection of building

| Day | Date | Outdoor Temperature (degree Celsius) | | Mean Temperature | In door temperature (degree Celsius) | Wind (km/hr.) | Sun Shine (hr.) |
|---|---|---|---|---|---|---|---|
| | | max. | min. | | | | |
| 1 | 15-12-2016 | 30.0 | 20.5 | 25.3 | 19.5 | 5.1 | 0.6 |
| 2 | 16-12-2016 | 31.5 | 19.0 | 25.3 | 20.3 | 4.2 | 7.3 |
| 3 | 17-12-2016 | 31.9 | 15.0 | 23.5 | 20.6 | 3.8 | 5.3 |
| 4 | 18-12-2016 | 32.1 | 16.0 | 24.1 | 19.8 | 3.6 | 6.5 |
| 5 | 19-12-2016 | 31.5 | 14.0 | 22.8 | 21.2 | 3.4 | 6.7 |
| 6 | 20-12-2016 | 31.5 | 12.2 | 21.9 | 20.2 | 2.6 | 7.1 |
| 7 | 21-12-2016 | 32.0 | 12.1 | 22.1 | 24.0 | 2.3 | 6.9 |
| 8 | 22-12-2016 | 31.8 | 12.0 | 21.9 | 23.6 | 2.0 | 7.7 |
| 9 | 23-12-2016 | 33.5 | 10.2 | 21.9 | 22.7 | 1.9 | 8.4 |
| 10 | 24-12-2016 | 32.0 | 11.0 | 21.5 | 22.5 | 2.2 | 8.1 |
| 11 | 25-12-2016 | 32.3 | 13.0 | 22.7 | 21.9 | 3.5 | 7.0 |
| 12 | 26-12-2016 | 32.3 | 13.0 | 22.7 | 21.4 | 2.5 | 7.2 |
| 13 | 27-12-2016 | 31.5 | 14.5 | 23.0 | 22.2 | 3.2 | 8.3 |
| 14 | 28-12-2016 | 32.0 | 15.0 | 23.5 | 22.7 | 3.7 | 6.6 |
| 15 | 29-12-2016 | 31.5 | 15.0 | 23.3 | 19.4 | 2.3 | 8.1 |
| 16 | 30-12-2016 | 32.0 | 15.5 | 23.8 | 19.8 | 6.4 | 8.3 |
| 17 | 31-12-2016 | 31.5 | 15.0 | 23.3 | 21.1 | 2.0 | 7.8 |
| 18 | 01-01-2017 | 31.5 | 15.5 | 23.5 | 21.7 | 2.9 | 8.3 |
| 19 | 02-01-2017 | 31.5 | 14.5 | 23.0 | 20.3 | 2.3 | 7.9 |
| 20 | 03-01-2017 | 31.6 | 15.0 | 23.3 | 20.5 | 3.5 | 8.6 |
| 21 | 04-01-2017 | 31.0 | 17.0 | 24.0 | 22.5 | 2.6 | 7.9 |
| 22 | 05-01-2017 | 31.5 | 16.0 | 23.8 | 24.2 | 2.1 | 8.8 |
| 23 | 06-01-2017 | 31.2 | 16.0 | 23.6 | 21.6 | 3.3 | 8.3 |
| 24 | 07-01-2017 | 31.0 | 17.0 | 24.0 | 20.2 | 2.9 | 8.3 |
| 25 | 08-01-2017 | 32.0 | 16.0 | 24.0 | 19.1 | 3.2 | 7.3 |
| 26 | 09-01-2017 | 31.5 | 14.5 | 23.0 | 19.8 | 3.8 | 8.3 |
| 27 | 10-01-2017 | 32.0 | 16.0 | 24.0 | 23.4 | 4.2 | 8.1 |
| 28 | 11-01-2017 | 31.5 | 17.0 | 24.3 | 22.2 | 3.3 | 8.0 |
| 29 | 12-01-2017 | 31.6 | 17.0 | 24.3 | 24.0 | 2.6 | 8.6 |
| 30 | 13-01-2017 | 31.0 | 17.0 | 24.0 | 23.6 | 3.8 | 8.5 |
| | | | | **22.6** | **21.5** | | **7.5** |

## 2.3. Temperature

The recorded temperature surrounding the building and internal temperature in the building is noted .The indoor temperature in the building is 22.6°C and the outdoor temperature around the building is 21.533°C. The Average temperature throughout 30 days of observation looks to be good, but the observation was done in the winter season. As the location comes under hot humid climatic zone, in summer excessive heat will be recorded. The increase in heat may be 10°C to 15°C this may lead to excessive increase of indoor temperature of room in the building. This may lead to usage of coolants in the building in summer to avoid heat.

## 2.4. Wind

Wind is the another most important consideration where this makes the free air movement in the living room .The average wind surrounding the building throughout the observation is found to be 4.5kmph

## 2.5. Sun-Shine

It is measured in terms of no. of hours when the sun appears clearly in the sky. This determines the daylight in the building and the average hours of the sunshine is 7.5 hours.

# 3. ANALYSIS

From the above collected data the analysis has been done for the existing residential building where their affects and remedies are discussed.

## 3.1. Building Plan

The typical building plan was shown in the Fig. 1 as the building was designed by KK estates, the building was oriented towards the south direction and located in Guntur, Andhra Pradesh. The flats contain 3BHK flats sharing 2 per floor with a living room, kitchen and attached bath rooms for every bedroom.

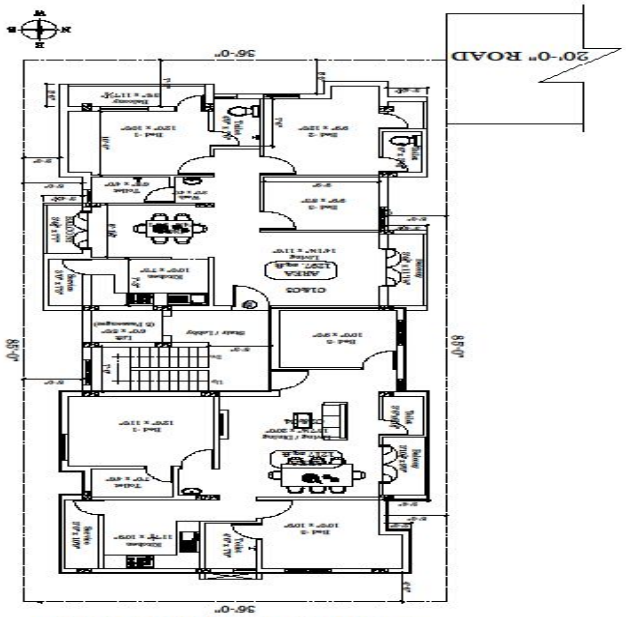


**Figure 1** Typical Building Plan

## 3.2. Building Orientation

From the above Fig .1. the building was facing north and the main gate was facing west but the flats in the building are assembled in a manner such that one flat is facing main door to the east and the other to west .Due to this the sunlight directions are covered by the opposite flats, hence this decreases the day lightning and it is mentioned as one of the demerit in the building.

## 3.3. Lighting

The lighting observed in the building was not up to mark as the main day lighting directions are closed and this make the increase of electricity usage in the building, so to regulate this issue additional windows to be provided or else a balcony to be arranged to the living room. As one of the flat facing west side has a balcony connected to the living room. But the building which is associated in that direction reduces sunlight entering the room. Even though the sunshine which is noted from the outer environment was at an average of 7.5 hours. But this doesn't favour the lighting into the building.

### 3.4. Ventilation

Ventilation means that to allow external air in the building by removing the pollutants from the building, simply it can be stated as free movement of air into the building from the outer environment. Considering the buildings ventilation, the building was surrounded with the obstacles on the three sides that is on east, north and south. Obstacle in the sense (buildings) that are placed around the present existing building. These obstacles are effecting the free air movement. The factors that affect the ventilation are climate, building design and human behaviour.

Discussing the factors, the climate surrounding the building was perfect within the 30days of data observation, but if we look forward to summer there will be excessive heat from sun will affect the ventilation. As the hot air enters the building and damage the comfort of the people living in it.

The data collected from the existing building has been discussed and the demerits has been summed up. To rectify these demerits the following recommendations to be considered.

## 4. RECOMMENDATIONS

Some recommendations has been suggested to make the energy efficient and green efficiency for the existing residential building.

### 4.1. Temperature

The first and foremost recommendation should be regarding temperature According to the data observed it has been known that the average temperature 21.5°C. The human comfort temperature is 21°C, So there is nothing to rectify in the winter season .The climatic zone of location is hot-humid .so there will be excess heat in the summer season. To overcome this issue the building should be equipped with energy star equipment like Air conditioners.

### 4.2. Proper Insulation

The building roof must be provided with proper POP (plaster of parries) insulation. Using POP the room will get cooled due to its heat absorption nature. The people living in the top floor of the building will experience too much heat, so the houses in the top floor should be provided adequate insulation.

### 4.3. Building Orientation

From Table 3 by implementing the examples, the temperature should be collected, stored, distributed and can be controlled. In the orientation, the use of materials and ventilation was the most effective things to make the buildings efficient.

**Table 3** Solar Function and action to perform

| Solar Function | Example Construction/Material/Action |
|---|---|
| Collect | South-facing glazing |
| Store | Masonry, water, other mass |
| Distribute | Radiation, convection, other natural heat transfer |
| Control | Light shelves, insulation, light-shaded paints |

### 4.4. Eco Friendly Lighting

The electricity usage was very high in the building .This is one of major element in the energy consumption of building, so as to control this consumption .Usage of CFLs, T5 and LED bulbs to be considered for lighting in the house. This will provide same amount of light as ordinary bulb using 75% less energy

### 4.5. Installation of Solar Panels

The electricity consumption in the building was very high and to control this issue. The installation of solar panels should be done. By installing this technique we can consume the natural energy and later convert it into electrical energy. Hence we can avoid the use of non-renewable energy. For example: A three phase generator is arranged for the working of lift and to use this technique when there is an interruption in electricity .So installing solar panels can save fossil fuels and can conserve natural energy.

### 4.6. Environmental Protection

As the availability of trees surrounding the building was less, heat is emitted and other emission of carbon gases from generator and vehicles are also liberated. To control these environmental damages, a forestation to be implemented and reuse of heated gas from kitchen can be used as steam electricity. By planting the trees the carbon gases can be reduced and oxygen levels can be improved in and around the locality of building .Hence the locality of the building will also resembles as greenery.

### 4.7. Ventilation

In the kitchen to remove the heat generated from the room, a heat outlet should be arranged and an exhauster to be installed to remove hot air from the building.

## 5. CONCLUSION

From the previous research on residential building and the present investigation on the residential building it is concluded that the resident people living in the building should implement heating and cooling agents systems to meet thermal comfort of the room. Along with these the people in the society should be aware of using green buildings technology at the initial stage of planning and design of building. Hence more attention to be taken for ventilation, lighting and environmental protection.

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